WHAT IS CLAIMED IS:

1. A polarization-insensitive integrated wavelength converter comprising:

a wavelength converter having first and second input/output ports;

a polarization separator having a first port for receiving an input optical signal, a second port providing a first component of the input optical signal in a first polarization mode, and a third port providing a second component of the input optical signal in a second polarization mode, with the second port of the polarization separator optically coupled to the first input/output port of the wavelength converter; and

a polarization rotator coupling the third port of the polarization separator to the second input/output port of the wavelength converter that rotates the polarization mode of an optical signal propagating through the polarization rotator.

2. The apparatus of claim 1 wherein said polarization rotator comprises an electro-optic half-wave retarder;

3. The apparatus of claim 1 wherein said polarization rotator comprises a half-wave plate;

4. The apparatus of claim 2 further including a bent waveguide;

5. The apparatus of claim 1 wherein said polarization rotator comprises an electro-optic quarter-wave retarder.

6. The apparatus of claim 1 wherein said polarization rotator comprises a quarter-wave plate.

7. The apparatus of claim 4 further including a mirror.

8. The apparatus of claim 1 wherein said polarization rotator comprises an optical fiber having a 90° twist to change the polarization mode.

9. The apparatus of claim 1 wherein said polarization rotator comprises:

a plurality of light signal propagating paths;

wherein said wavelength converter comprises:

a plurality of processing channels, each having a second input/output port coupled to a respective light signal propagating path; and

wherein said polarizing beam splitter comprises:

a plurality of channels coupling the processing channels and light signal propagating paths.

10. The apparatus of claim 1 wherein at least a portion of said wavelength converter comprises a quasi-phasematched structure.

11. The apparatus of claim 10 wherein at least a portion of said quasi-phasematched structure is incorporated in lithium niobate.

12. The apparatus of claim 10 wherein at least a portion of said quasi-phasematched structure is incorporated in magnesium-oxide-doped lithium niobate.

13. The apparatus of claim 10 wherein at least a portion of said quasi-phasematched structure is incorporated in lithium tantalate.

14. The apparatus of claim 10 wherein at least a portion of said quasi-phasematched structure is incorporated in magnesium-oxide-doped lithium tantalate.

15. The apparatus of claim 1 further comprising a waveguide structure.

16. The apparatus of claim 15 further wherein said waveguide structure includes a proton-exchanged waveguide.

17. The apparatus of claim 15 further wherein said waveguide structure includes an annealed-proton-exchanged waveguide.

18. The apparatus of claim 15 further wherein said waveguide structure includes a zinc-diffused waveguide.

19. The apparatus of claim 15 further wherein said waveguide structure includes a metal-diffused waveguide.

20. The apparatus of claim 15 further wherein said waveguide structure includes a titanium-diffused waveguide.

21. The apparatus of claim 15 further wherein said waveguide structure includes a buried waveguide.

22. The apparatus of claim 15 further wherein said waveguide structure includes a reverse-proton-exchange waveguide.

23. The apparatus of claim 1 further comprising an optical circulator having a port coupled to the first port of the polarizing beam splitter.

24. The apparatus of claim 1 further comprising an electro-optic phase modulator for modifying the phase of at least one of the components of the optical signal.

25. The apparatus of claim 1 further comprising an electro-optic phase modulator for modifying the phase of at least one of the components of the optical signal.

26. The apparatus of claim 1 wherein input optical signal comprises a plurality of optical signals.

27. A polarization-insensitive integrated wavelength converter comprising:

a wavelength converter substrate;

a polarization separator serving to separate an input optical signal into first and second signal components having orthogonal polarization modes.

a polarization rotator serving to rotate the polarization mode of at least one of said first and second signal components,

a wavelength converter structure for receiving said signal components and generating converted signal components

28. The apparatus of claim 27 in which said converted signal components comprise a frequency-converted input signal.

29. The apparatus of claim 27 in which said converted signal components comprise an amplified input signal.

30. The apparatus of claim 27 in which said input signal includes a pump signal.

31. The apparatus of claim 27 in which said converted signal components include a frequency-doubled pump signal.

32. The apparatus of claim 27 further comprising

an optical circulator structure for providing isolation between the converted signal and an input signal source.

33. The apparatus of claim 32 wherein said circulator further comprises a first port coupled to said input signal source for receiving said input optical signal, a second port coupled to said polarization separator, and a third port for providing converted signal.

33b. The apparatus of claim 32 wherein said circulator is integrated into said wavelength converter substrate.

34. The apparatus of claim 27 further comprising an input port for receiving and transmitting one or more input optical signals.

35. The apparatus of claim 27 wherein said polarization separator includes a first port for receiving said input optical signal, a second port for transmitting a first component of said input optical signal in a first polarization mode, and a third port for transmitting a second component of said input optical signal in a second polarization mode.

36. The apparatus of claim 27 wherein said polarization rotator includes a coupler for providing coupling between said polarization separator and said wavelength converter structure.

37. A polarization-insensitive integrated wavelength converter comprising:
a wavelength converter substrate;
a first waveguide, formed in said substrate, capable of supporting both TM and TE polarization modes and having first and second input/output ports;
a second waveguide, formed in said substrate, capable of supporting at least one of TM and TE polarization modes and having first and second coupling sections disposed near said first waveguide to evanescently couple light signals between said first waveguide and said second waveguide;
a reflector coupled to the second input/output port of said second waveguide;
a polarization rotator region disposed between the first and second coupling sections;
a wavelength converter region formed in at least one of the first waveguide and second waveguide; and

a coupler serving to couple said wavelength converter region to said polarization rotator region.

4 38. A polarization-insensitive integrated wavelength converter comprising:

a converter substrate;

a first waveguide, formed in the substrate, having first and second input/output;

a second waveguide, formed in the substrate, having first and second coupling sections to evanescently couple light signals between the first waveguide and the second waveguide (supporting only TE polarization modes);

a polarization rotator region disposed on the first waveguide (between the second coupling section and the second input/output port of first waveguide);

a reflector coupled to the second input/output port of the first waveguide; and

a wavelength converting structure formed in at least one of the first waveguide and second waveguide.

39. The apparatus of claim 38 wherein said first waveguide is capable of supporting optical signals having both TE and TM polarization modes.

40. The apparatus of claim 38 wherein said first waveguide includes a metal waveguide.

41. The apparatus of claim 38 wherein said first waveguide includes a buried waveguide.

42. The apparatus of claim 38 wherein said first waveguide includes a diffused waveguide.

43. The apparatus of claim 38 wherein said first waveguide includes a Zinc waveguide.

44. The apparatus of claim 38 wherein said first waveguide includes a Titanium waveguide.

45. The apparatus of claim 38 wherein said second waveguide includes a proton-exchanged waveguide.

46. The apparatus of claim 38 wherein said second waveguide includes an annealed- proton-exchanged waveguide.

47. The apparatus of claim 38 wherein said second waveguide includes a buried waveguide.

48. The apparatus of claim 38 wherein said polarization rotator includes a wave plate.

49. The apparatus of claim 38 wherein said polarization rotator includes a quarter-wave plate.

50. The apparatus of claim 38 wherein said polarization rotator includes a half-wave plate.

51. The apparatus of claim 38 wherein said polarization rotator includes an electro-optic wave plate.

52. The apparatus of claim 38 wherein said polarization rotator is positioned near said first waveguide.

53. The apparatus of claim 38 wherein said polarization rotator is positioned near first waveguide between said first coupling section and said second coupling section.

54. The apparatus of claim 38 wherein said polarization rotator is positioned near first waveguide between said second coupling section and said reflector.

55. The apparatus of claim 38 wherein said polarization rotator includes a waveplate inserted into a saw cut in said converter substrate.

56. The apparatus of claim 38 wherein said polarization rotator includes a waveplate fastened to the end of said converter substrate.

57. The apparatus of claim 38 wherein said polarization rotator includes a waveplate fastened between the end of said converter substrate and said reflector.

58. The apparatus of claim 38 wherein said reflector serves to reflect said input signals.

59. The apparatus of claim 38 wherein said reflector serves to reflect said converted signals.

60. The apparatus of claim 38 wherein said reflector serves to reflect pump signals.

61. The apparatus of claim 38 wherein said reflector serves to transmit frequency-doubled pump signals.

62. The apparatus of claim 38 wherein said reflector serves to reflect frequency-doubled pump signals.

63. The apparatus of claim 38 wherein said reflector serves to transmit said input signals.

64. The apparatus of claim 38 wherein said reflector serves to transmit said converted signals.

65. The apparatus of claim 38 wherein said reflector serves to transmit pump signals.

66. The apparatus of claim 38 wherein said wavelength converting structure includes a ferroelectric crystal.

67. The apparatus of claim 38 wherein said wavelength converting structure includes a periodically-poled ferroelectric crystal capable of performing quasi-phasematching.

68. The apparatus of claim 38 wherein said wavelength converting structure includes lithium niobate.

69. The apparatus of claim 38 wherein said wavelength converting structure includes magnesium-doped lithium niobate.

70. The apparatus of claim 38 wherein said wavelength converting structure includes congruent lithium niobate.

71. The apparatus of claim 38 wherein said wavelength converting structure includes stoichiometric lithium niobate.

72. The apparatus of claim 38 wherein said wavelength converting structure includes lithium tantalate.

73. The apparatus of claim 38 wherein said wavelength converting structure includes magnesium-doped lithium tantalate.

74. The apparatus of claim 38 wherein said wavelength converting structure includes congruent lithium tantalate.

75. The apparatus of claim 38 wherein said wavelength converting structure includes stoichiometric lithium tantalate.

76. The apparatus of claim 38 further including an electro-optic index modulator positioned near at least one of first waveguide and second waveguide, said modulator serving to control the optical path length of waveguides near said modulator.

77. A polarization-insensitive integrated wavelength converter comprising:

a wavelength converter, having a gain level, for receiving said component input signals and generating component converted signals,

a polarization separator for separating an input signal into component input signals having orthogonal polarization modes,

a polarization rotator for rotating the polarization modes of said component input signal and optical signal propagating through the polarization rotator, and

an interchannel crosstalk modulator, comprising a detector and modulator structure, serving to detect levels of interchannel crosstalk between wavelength-converted optical signals whereby one or more of the amplitude of input optical signals and converter gain level are modified accordingly to reduce interchannel crosstalk.

78. The apparatus of claim 77 wherein said wavelength converter includes controls for modifying the gain level of at least of said converted signal, said input signal and a pump signal.

79. The apparatus of claim 77 wherein said controls include an optical parametric amplifier for providing said gain level.

80. The apparatus of claim 77 wherein said controls include an EDFA for providing said gain level.

81. The apparatus of claim 77 wherein said controls include a pump diode for providing said gain level.

82. The apparatus of claim 77 wherein said controls include a semiconductor optical amplifier for providing said gain level.

83. The apparatus of claim 77 wherein said controls include an optical attenuator.

84. The apparatus of claim 77 further including an optical filter structure for discriminating between said input signals, said converted signals, pump signals and non-converted signals.

85. The apparatus of claim 84 wherein said optical filter structure includes at least one optical interleaver. .

86. The apparatus of claim 84 wherein said optical filter structure includes at least one arrayed waveguide.

87. A polarization-insensitive integrated wavelength converter comprising:
a wavelength converter having an input/output port;
a polarization separator having
a first port for receiving an input optical signal, optically coupled to the input/output port of the wavelength converter,
a second port providing a first component of the input optical signal in a first polarization mode, and

a third port providing a second component of the input optical signal in a second polarization mode,

a wavelength converting structure having a first port and a second port, said first port being coupled to the second port of the polarization separator, serving to provide wavelength conversion on said input optical signal,

a polarization rotator coupling the second port of the wavelength converting structure to the third port of the polarization separator, serving to rotate the polarization of the said input signal.

88. A polarization-insensitive integrated wavelength converter comprising:

a polarization separator having two or more waveguides that support orthogonal polarization modes of an input signal,

a wavelength converting structure, serving to provide wavelength conversion on said input optical signal, a polarization rotator, serving to rotate the polarization of the said input signal, and a coupler serving to optically couple said waveguides.

89. A polarization-insensitive integrated wavelength converter comprising:

a waveguide that supports an input signal having a plurality polarizations,

a wavelength converting structure, serving to provide wavelength conversion on at least one polarization mode of said input optical signal, a polarization rotator, serving to rotate the said plurality of polarizations of the said input signal, and a reflector serving to reflect said input signal back through said wavelength converting structure.

90. A polarization-insensitive integrated wavelength converter comprising:

at least one polarization splitter comprising a first waveguide that supports an input signal having a plurality polarizations, and a second waveguide that supports at least one polarization mode of said input signal, a wavelength converting structure serving to provide wavelength conversion on at least one polarization mode of said input optical signal, and a polarization rotator, serving to rotate the polarizations of said input signal in at least one of first or second waveguides.

91. A polarization-insensitive integrated wavelength converter comprising:

at least one polarization splitter comprising a first waveguide that supports an input signal having a plurality polarizations, and a second waveguide that supports one

polarization mode of said input signal, a wavelength converting structure, serving to provide wavelength conversion on at least one polarization mode of said input optical signal, and a lens, wave plate and reflector assembly serving to optically couple said first and second waveguides.

92. The apparatus of claim 91 wherein said wavelength conversion structure further comprises an optical frequency synthesizer, serving to provide frequency translation on said input signals.

93. A polarization-insensitive integrated wavelength converter comprising:
an optical circulator;
a substrate;
a waveguide, formed in said substrate, capable of supporting both TM and TE polarization modes and having first and second input/output ports;
a polarization rotator region disposed at the second input/output port;
a reflector coupled to said polarization rotator region; and a wavelength converter region formed in the waveguide.

94. A polarization-insensitive integrated wavelength converter comprising:
a substrate;
a waveguide, formed in said substrate, capable of supporting both TM and TE polarization modes and having first and second input/output ports;
a polarization rotator region disposed at the second input/output port;
a reflector coupled to said polarization rotator region; and a wavelength converter region formed in the waveguide.